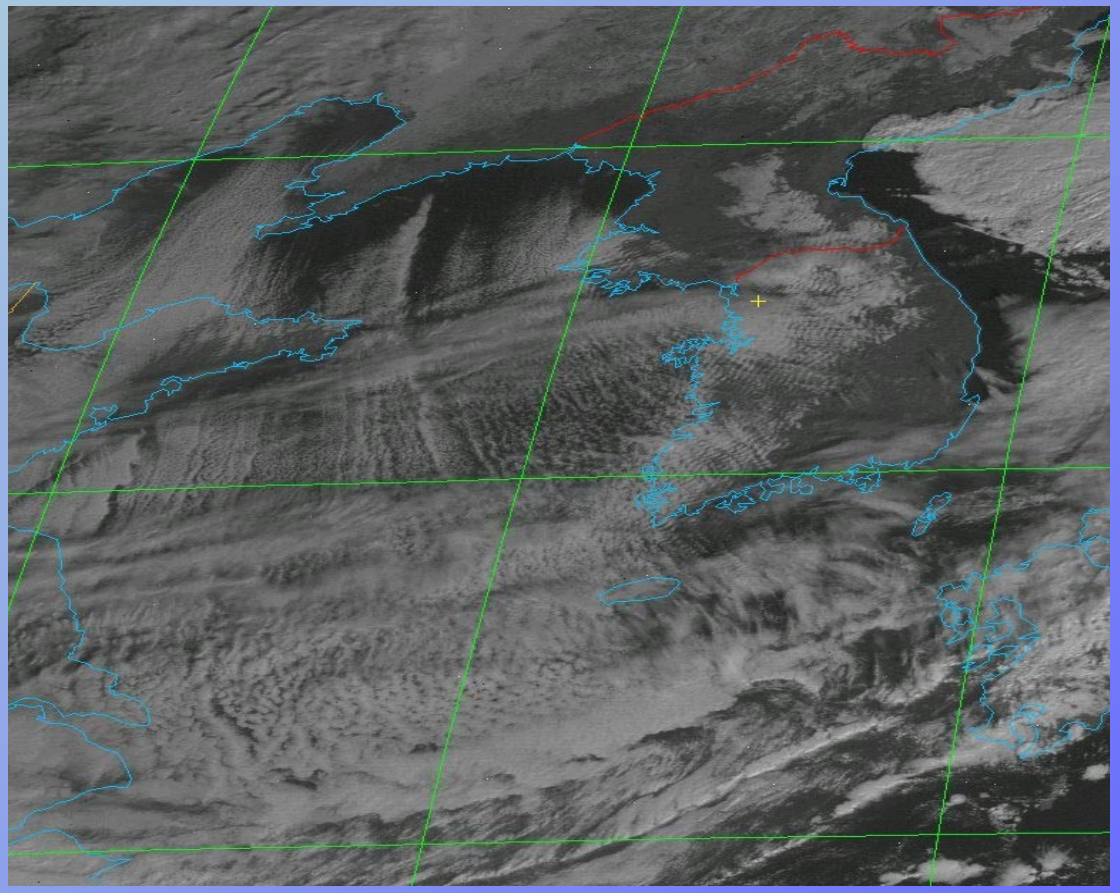
LAKE EFFECT SNOW

- Occurs on the lee of the West Sea during winter
- Polar/Arctic air travels across the West Sea, picks up heat and moisture, and is destabilized
- Cloud formation is enhanced by thermal and frictional convergence and upslope along the lee shore
- Occurs when the West Sea temperatures exceed mean land temperatures

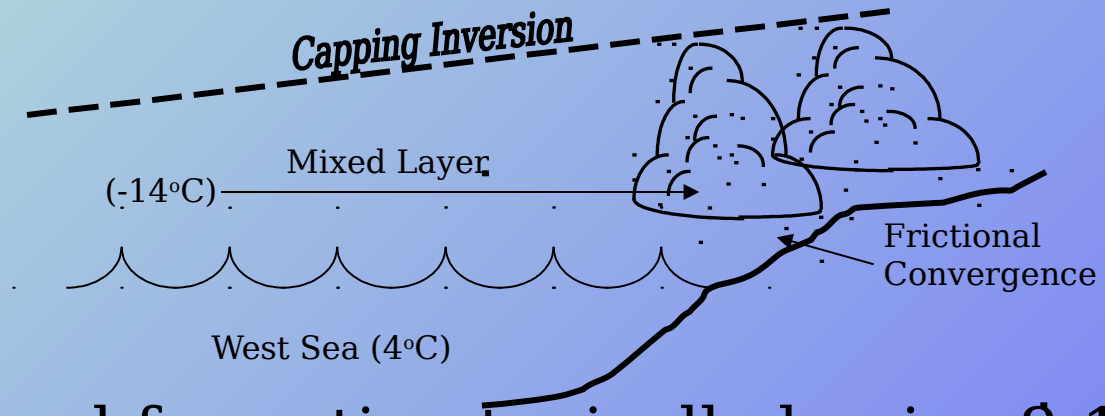
Multiple Snow Bands

- Weaker than single bands
- Gradient level winds normal to long axis of West Sea
- Oriented parallel to gradient level winds



Conceptual Model of Lake Effect

- Heat and moisture from West Sea + frictional convergence + upslope flow = clouds and lake effect precipitation



- Cloud formation typically begins 8-12 hours after frontal passage

Ingredients Determining Lake Effect Characteristics

- Instability
- Fetch
- Wind shear
- Upstream moisture
- Synoptic-scale forcing
- Orography/Topography

Instability

- Depth of Instability:
  - Relates to depth of mixed layer. Difficult to get snow if depth of mixed layer is <1-1.5km
- Degree of Instability:
  - Temp West Sea – Temp 850mb $\geq$ 17^{o}C give absolute instability/vigorous heat and moisture transport

Fetch

- Distance air travels over water – relates to wind direction
  - Typically, stratocumulus lines form just downstream from northern West Sea
- Gradient level wind flow is key as to what areas receive snow
  - Uninterrupted fetch for Seoul is westerly up to 280^{o}
  - Uninterrupted fetch for Osan is westerly up to 300^{o}
  - Uninterrupted fetch for Kunsan is west-northwesterly up to 340^{o}

Wind Shear

- Directional turning significantly impacts character (cloud formation)

SFC-700mb Dir Change	Character
0-30°	Strong, well organized bands
30-60°	Weaker bands
>60°	Nothing/possible flurries

Wind Shear

- Low-level winds must have cyclonic curvature
  - Low-level convergence necessary for increased instability and cloud formation

Synoptic Scale Forcing

- Positive vorticity advection aloft may enhance lake effect by lifting the capping inversion.
- Cold air advection aloft may enhance lake effect by increasing the instability.

Topography

- Lake effect increases with elevation to the lee of the West Sea
  - Convergence enhanced along western shores due to friction (causes winds to back and slow)
  - Orographic lift aids by increasing vertical depth of clouds

ROT for Korea Lake Effect

- Two parameters should make you reach for this rule-of-thumb:
  1. Strong pressure gradient (mixing)
  2. Strong cold air advection (instability)

- All parameters must be a “GO” for lake effect snow to occur

ROT

- ✓ 850mb wind flow cyclonic or neutral (***low-level convergence***)
- ✓ Sea surface temp – 850mb temp ≥17°C (heavy snow can be implied when temperature differential is ≥20°C) (***instability***)
- ✓ 850mb winds 250° to 340° (***uninterrupted fetch***)
- ✓ 850mb winds ≥ 20 knots (***mixing***)
- ✓ 850 temp <-8°C (Nov-Dec/Mar) (***cold enough***
  <-6°C (Jan-Feb) ***for solid precip***)
- ✓ 1000-500mb thickness isopleth ≤528
- ✓ Freezing level <1200 feet

Other Considerations

- Be careful of post cold frontal troughing – this can change the gradient wind flow (see 1999 heavy snow bust review)
- These are shallow systems (depth often <3km) and the lowest elevation radar scans can overshoot the tops.
- The onset, intensity, orientation, and exact location are very sensitive to wind shear/direction

Other Considerations

- Conventional Skew-T data measures profiles at times and locations which are not optimum for monitoring the atmosphere over the West Sea
- Operational models often do not have sufficient resolution to resolve the scales of lake-effect snow bands (be sure to initialize and verify the model carefully)

Other Considerations

- Use visual METSAT to help determine low-level wind flow.
- Typically, the closer the CASC forms in relation to upstream land mass, the more significant the episode is going to be.
- Once the CASC field starts to pull away from upstream land mass, the event is over.
- Once WAA begins, the snow showers end.

Other Considerations

- Typically, if PVA is above a field of SHSN, visibility can drop to 0400-0800 meters and ceilings as low as 300-500 obscured.
- Trajectory bulletins: FXPA41 and 42
- MM5 inner nest (5km window) does a good job on formation and coverage, but still under forecasts amount.
- West Lake Baikal High outbreaks are responsible for significant amounts of snow – winter 2000 saw an event at Kunsan where over 24 inches of snow accumulated in less than 36 hours